

BIOLOGICAL RHYTHMS AND SHIFT WORK

SHIFT WORK AND NURSING

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This contractor document was prepared for the OTA report entitled *Biological Rhythms and Shift Work*. It is being made available because it contains much useful information beyond that used in the OTA report. However, it is not endorsed by OTA, nor has it been reviewed by the Technology Assessment Board. References to it should cite the contractor, not OTA, as the author.

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I. Registered Nurses: An Overview

Registered nurses (RNs) comprise the largest health care profession.¹ According to the 1988 National Sample Survey of Registered Nurses, there were 2,033,032 RNs licensed to practice in the United States in 1988, of whom 1,627,035 (80%) were employed in nursing positions (Moses, 1989). The total number of licensed RNs, the number employed in nursing, and the nurse-to-population ratio have all been increasing: the number of RNs employed in nursing in March 1988 represents a 10% increase over the number employed in November 1984 and an increase in the nurse-to-population ratio from 629 per 100,000 in 1984 to 668 per 100,000 in 1988 (U.S. Department of Health and Human Services, HRSA, 1988; Moses, 1989). Despite these increases in supply, much attention has been devoted recently to a perceived shortage of RNs, due to declining enrollments in basic nursing education programs and increasing demand for RNs in the nation's health care delivery system (Rosenfeld, 1988; U.S. Department of Health and Human Services, Secretary's Commission, 1988).

Registered nurses are licensed to practice by the states, and there are several types of basic educational preparation for licensure: hospital-based diploma programs, associate degree programs, baccalaureate degree programs, and a very small number of programs leading to a master's or doctoral degree as the first

professional degree. In 1988, 36% of RNs employed in nursing held a baccalaureate or higher degree, 28% held an associate degree as the highest degree, and 37% held only diplomas (Moses, 1989).

Because of declining numbers of diploma programs and graduates, diploma nurses are declining as a proportion of all RNs. By the end of the year 2000, about 43% of the RNs population are projected to hold baccalaureate or higher degrees (U.S. Department of Health and Human Services, HRSA, 1988).

Nursing is a women's profession. In 1988, only 3% of registered nurses were men. In addition, 71% of RNs were married, and 54% had at least one child living at home. One-half of all RNs in 1988 were under age 40, and 63% were under age 45. Thus the majority of nurses are living in families or are in the childbearing years. These sociodemographic factors have implications for shift work, as will be discussed later.

Of those employed in nursing in 1988, 68% were working full-time schedules and 32% were working part-time schedules. Hospitals traditionally have been the principal employer of RNs and remained so in 1988: 68% of employed registered nurses worked in hospitals, and no other single type of employment setting accounted for more than 8% of employed nurses. Nursing homes and other longterm care facilities employed only 7% of RNs in 1988. Ninety percent of RNs employed in hospitals in 1988 worked in non-federal, short-term hospitals, 6% worked in federal government

hospitals, and 4% worked in non-federal, long-term hospitals.

Among RNs working in hospitals on March 23, 1988, 2.7% (or, 30,358

RNs) were working through a temporary employment service (Moses, 1989).

II. Shift Work in Nursing

A. Prevalence

No national survey of registered nurses provides estimates of the prevalence of shift work or of the number of years the typical RN spends in shift work during her career.² However, since the organizations in which the vast majority of nurses are employed (primarily hospitals, but also nursing homes and other extended care facilities) require 24-hour operations, it is likely that a sizeable proportion of RNs are engaged in shift work. Data from the 1988 Hospital Nursing Personnel Surveys show that among 764 responding community hospitals, an average of 71% of RNs were reported to work some non-daytime hours and an average of 33% of RNs worked some combination of day, evening, and night shifts, including rotating all three shifts; furthermore, only 7% of RNs had every weekend off (Adams, 1989).

A 1985 National Nursing Home Survey reported that 46% of RNs employed in nursing homes in 1985 worked other than regular daytime hours, and 9% worked rotating shifts (National Center for Health Statistics, 1988). The smaller proportion of RNs rotating shifts in nursing homes as compared with hospitals may be attributed to the fact that nursing home RNs are more likely to be in supervisory positions rather than staff nurse positions.

Estimates for the total U.S. labor force suggest that the degree of shift work in nursing is greater than for women workers in the general U.S. labor force. According to data collected on wage and salary workers age 16 years and over in a May, 1985 special supplement to the Current Population Survey, 13% of full-time women workers and 43% of part-time women workers worked some type of shift work. Among full-time workers in health assessment and treating occupations, the category that includes registered nurses, 31.3% worked some type of shift work; rotating shifts were the most frequent type of shift work in these occupations. The only occupational categories with higher proportions of shift workers were protective service workers, food service workers, and ancillary health service workers such as nurses' aides (Mellor, 1986).

Flexible scheduling, or flexitime, is a recent innovation that allows workers to vary the times they begin and end their workday and/or the number of hours they work per day, as long as they are present during core times. Flexible scheduling tends to be available more often in scientific and technical occupations, in Federal Government agencies, and among day workers. In May, 1985, 11.1% of full-time women wage and salary workers and 18.0% of part-time women wage and salary workers in the United States reported having flexible scheduling. Men in both categories were somewhat more likely than women to have access to flexible scheduling (Mellor, 1986).

B. Patterns

Traditionally, hospitals and nursing homes have operated on three eight-hour shifts (day, evening, and night shifts), with nurses typically working five eight-hour shifts per week on either a fixed or rotating basis and including weekend work.³ Shifts typically overlap for one-half hour, during which nurses leaving the unit may communicate with those arriving regarding patient status, anticipated admissions, and so on. In hospitals, the pattern of activity varies by time of day, so that the task requirements and work load of nurses may vary by shift. Night shifts are generally considered to be slower-paced and to require a smaller complement of nursing personnel, since most patients are asleep and few procedures take place at night. On the other hand, night nurses are expected to be able to manage emergencies when other services are not readily available.

Organizational policies regarding shift patterns (e.g. timing and length of shifts, patterns of shift rotation), the method of shift assignment (e.g. the degree to which nurses can control their assignments by bidding on preferred shifts or trading shifts), and compensation for shift work (e.g. use of hourly wage differentials as incentives for undesirable shifts) are determined by the employing organizations and vary widely. In some decentralized organizations, these policies are determined

at the unit level. Some aspects of shift work, such as requirements regarding rotation, mandatory overtime, or shift differentials, become issues in collective bargaining by nurses, although only 20% of hospitals report having organized collective bargaining (predominantly through state nurses' associations) for RNs (Adams, 1989).

Typically, head nurses have authority over shift assignments for staff nurses and resolve scheduling conflicts. Shift assignments generally are posted for a one-month period and one month in advance, although this may vary within and between organizations. Assignments to undesirable shifts (e.g. night or weekend work, rotating shifts as opposed to fixed shifts) are often an inverse function of seniority. Rewarding seniority with more desirable shifts is cited as a retention strategy by some nursing administrators (McLaughlin and Mohr, 1988).

According to the Health Care Advisory Board, there are six distinct hospital scheduling alternatives, although some are used in very few hospitals. The models are:

- (1) the traditional five 8-hour shifts per week, including rotation within a one-week cycle,
- (2) the "Baylor Plan," consisting of 2 or 3 12-hour shifts for separate weekend staff, with the regular staff working traditional 8-hour shifts,
- (3) "4-40," consisting of 4 10-hour shifts per week,
- (4) "7-on, 7-off," consisting of 7 10-hour shifts on

alternative weeks, (5) "12-hour shifts," consisting of 3 12-hour shifts one week, 4 12-hour shifts the next, and (6) "customized schedules," involving choice of various shift lengths (Health Care Advisory Board, 1987).

Variations on these themes can be identified. For example, one hospital in North Carolina has reported a 12-hour shift system in which nurses work seven 12-hour days in succession, followed by seven days off (Ganong et al., 1976). At Johns Hopkins Hospital, a professional practice model has been in place on some nursing units since 1981 in which the nurses agree to provide 24-hour coverage of their unit in exchange for self-management and annual salaries; the model permits nurses to design their own shift systems and to make and monitor their own shift assignments (Dear et al., 1985).

Traditional eight-hour shifts continue to predominate in nursing: community hospitals report that nearly 79% of RNs, on average, work eight-hour shifts, 17% work 12-hour shifts, and 4% work other types of shifts, including partial shifts of 4-6 hours (Adams, 1989). Although a number of experiments with hospital shift lengths and patterns have been reported in the nursing literature, these appear to affect a relatively small proportion of registered nurses. Urban hospitals appear to be more innovative with regard to shift issues due to competition with other organizations for nursing staff (McLaughlin and Mohr, 1988).

Shift differentials are widely used by U.S. hospitals. In the 1988 Hospital Nursing Personnel Surveys, over 97% of hospitals reported paying hourly differentials to full-time and part-time RNs for evening and night shifts. However, only 41% of hospitals reported paying hourly differentials for weekend shifts (Adams, 1989). In 1987, the average hourly differential paid for evening shift by U.S. hospitals was \$0.79, and for night shift \$1.02 (AHA, 1987). Nonfinancial compensation for shift work (such as extra days off or child care) are rare. The effectiveness of shift differentials in attracting nurses to undesirable shifts is not known.

C. Evidence for Dissatisfaction with Shift Work

A number of polls and research studies conducted during the last decade provided evidence that shift work, and/or the nurse's perceived lack of control over scheduling, was associated with job dissatisfaction and/or job turnover. It should be noted, however, that there are very few prospective studies of job satisfaction and turnover in which multivariate analyses have been employed and the effects of shift work differentiated from the effects of other job, organizational, or personal attributes.

Results of a 1981 Texas survey of 3,500 nurses suggested that work overload and shift work issues were intermingled and that, in

general, nurses desired greater control over work assignments and scheduling (Wandelt et al., 1981). However, the job condition eliciting the most dissatisfaction was salaries. In a 1987 poll of 1,643 subscribers to Nursing 88, 76% of respondents reported increased work hours, 51% reported increased shift rotation, and 43% reported increased weekend work due to the current nursing shortage; in addition, 65% reported that a minimum of every other weekend off was most important in evaluating their present jobs, and 53% reported that a permanent shift assignment was most important. Salary and benefits were ranked equal in importance with a permanent shift assignment (Editors of Nursing 88, 1988).

A one-year prospective study of nursing job satisfaction and turnover conducted in two large university-affiliated hospitals asked 1,259 full-time nonsupervisory RNs to report their degree of satisfaction with their current and future pay levels, benefits, advancement opportunities, and scheduling of work hours; the nurses were least satisfied with hours scheduling (Weisman, 1982). In multivariate analyses for one of the hospitals in this study, working rotating shifts, as opposed to a fixed shift, was found to lower the nurse's perception of her degree of control over the work environment when other job and personal characteristics were controlled; lower perceived control, in turn, was the strongest predictor of job dissatisfaction. Shift work had no significant impact on perceived control in the second hospital, however

(Weisman et al., 1981).

Blegen and Mueller tested a multivariate causal model of effects of a set of variables on 370 RNs' job satisfaction in five short-term acute care hospitals in the Rocky Mountain region of the U.S. Measurements of satisfaction were made at two time points, eight months apart. Assignment to the day shift (rather than to evenings or nights) was associated with higher job satisfaction and, after controlling for satisfaction level at baseline and for a number of other job and personal characteristics, the effect of day shift on satisfaction was one of only two coefficients that remained statistically significant (Blegen and Mueller, 1987).

A cross-sectional study of 146 nursing units in 17 U.S. hospitals examined unit-level determinants of turnover rates. A higher degree of shift rotation among the RNs comprising a nursing unit was conceived as an indicator of lower staff cohesiveness, which was hypothesized to produce higher rates of turnover. In a multivariate analysis of unit turnover rates, degree of shift rotation was found to be a marginally significant ($p < .10$) predictor of turnover rates independent of other unit attributes including the degree to which RNs influence unit-level decision making (Alexander, 1988).

Only one randomized trial of different shift patterns in nursing has been reported. In a 788-bed tertiary-care hospital,

12 randomly selected medical-surgical units staffed by both registered and licensed practical nurses were randomly assigned to four treatments: fixed shifts; computer-assisted scheduling in which nurses' shift preferences were considered; select-a-plan, in which unit nurses designed their own scheduling system, typically combining 8- and 12-hour shifts; and a no-treatment control group. Pretest-posttest job attitudes were obtained from 98% of nurses, but the length of the followup is unspecified. The results did not indicate substantial differences between shift treatments on RNs' job attitudes or turnover at followup (Choi et al., 1986).

In addition to research studies, a number of commissions and task forces in recent years have recommended that health service organizations address the shift work issue. The Institute of Medicine's 1981 study of nursing and nursing education noted flexible scheduling as a strategy to increase nursing labor supply to hospitals and nursing homes (Institute of Medicine, 1983). The 1983 report by the National Commission on Nursing recommended that flexible scheduling should be developed as a component in models for organizational change in nursing (National Commission on Nursing, 1983). A study of magnet hospitals by the American Academy of Nursing's Task Force on Nursing Practice in Hospitals found that flexible scheduling and elimination of rotating shifts were among the four most important factors promoting recruitment and retention of nursing staff (American Academy of Nursing,

1983).

The 1988 report by the Secretary's Commission on Nursing cited work scheduling as a major source of stress among hospital RNs (U.S. Department of Health and Human Services, Secretary's Commission, 1988). Finally, a Commonwealth Fund Paper based on a study of 421 hospitals and over 15,000 nurses in six urban areas, recommended that hospitals offer varied and flexible schedules as a means of responding to the work preferences of nurses and resolving the current nursing shortage (Roberts et al., 1989).

Hence, a consensus appears to have developed regarding the need to provide shift work alternatives for nurses and to increase nurses' involvement in scheduling decisions.

III. Consequences of Shift Work in Nursing

A considerable body of research addresses the psychosocial, health, and work performance consequences of shift work in a variety of industries, although relatively little research has been conducted on women shift workers (Colligan, 1980). A few other methodological limitations of the literature are noteworthy. Few studies of shift work involve randomization, and results therefore may be subject to selection effects. For example, in nursing, type of shift is often confounded with age because younger, less experienced nurses tend to be assigned to rotating shifts. In addition, studies of shift work typically are cross-sectional or examine short-term effects; they less frequently consider length of time on a particular shift or prior exposure to shift work in analyzing long-term outcomes for the worker. In cross-sectional studies of health outcomes, it is rare to find controls for pre-existing health conditions that might have been exacerbated, rather than preceded, by shift work.

This discussion of consequences focuses on studies in which nurses have been subjects but will allude occasionally to studies of women shift workers, or to the absence of information about women shift workers, because of the predominance of women in nursing. Since job attitudes were summarized above, this section emphasizes other outcomes of shift work.

A. Family and Social Participation

Shift work can affect the individual's participation in the family, including child care, as well as participation in social activities outside the home and work place (Mott et al., 1965; Staines and Pleck, 1983). Shift work can reduce participation by requiring the individual to work during those hours when the family and community are engaged in normal activities and/or by causing sufficient fatigue to reduce the quality of the individual's role performance during nonworking hours. Feelings of social isolation may result and could contribute to health problems. Finn has summarized the evidence for effects of shift work on family roles, sexual activity, friendship patterns, and participation in voluntary organizations; however, all of the relevant studies have focused on men shift workers (Finn, 1981).

Presser and Cain have pointed out that in dual-earner couples in the U.S. in 1980, one-third had at least one spouse working other than regular day shift and 10% of couples worked schedules with no overlap in working hours. In such families, there is likely to be greater role flexibility, with, for example, the husband providing child care during the hours when the wife works (Presser and Cain, 1983). However, role adaptations in families in which the wife is a shift worker have not been studied.

A 1977 study of the health consequences of shift work

conducted by the Stanford Research Institute for the National Institute for Occupational Safety and Health (NIOSH) provides some information about effects of shift work on the family and social participation of nurses. Questionnaire data were obtained for 1,219 full-time, nonsupervisory registered nurses and licensed practical nurses in 12 U.S. hospitals; 98% of the sample was female, the average age was 32.9, and 45% were married. The nurses were fairly evenly distributed across four types of work schedules: fixed day shift, fixed afternoon or evening shift, fixed night shift, and rotating shift (generally rotation occurred between two shifts only) (Tasto et al., 1978).

Results showed that the greatest disruption of family and social participation occurs for nurses on rotating shifts. With regard to degree of satisfaction with the amount of time spent with their spouses, rotators and night shift nurses were most dissatisfied. Night shift nurses reported the most interference with sexual activities, whereas rotators reported the most complaints from spouses regarding their work schedules. With regard to amount of time spent with children, rotators were the least satisfied nurses, although afternoon/evening shift nurses reported that they assumed the least responsibility for childrearing and disciplining. Finally, rotators and afternoon shift nurses were least satisfied with the time available for personal activities, sports, and social activities (Tasto et al.,

1978).

Adaptations of family life to accommodate shift work has also received some research attention and is addressed below in connection with sleep disturbances.

B. Health

In the general literature on shift work, the health outcomes most frequently studied are sleep disturbances, gastrointestinal and digestive problems, perceived stress, substance use, and injuries (Colligan and Tepas, 1986; Finn, 1981; Gordon et al., 1986; Rutenfranz et al., 1977). Shift work, especially night work and rotating shifts, may affect health through its disruption of the individual's social participation (as discussed above) and/or by requiring individuals to work schedules that are not compatible with circadian rhythms (i.e., physiologic functions such as body temperature, pulse, blood pressure, and endocrine secretions that follow patterns of approximately 24 hours). Tolerance of night or rotating shift work varies widely, although rotating shift workers may have the most difficulty because of continual disruption of circadian rhythms, and permanent night workers face continual desynchronization with the social environment.

Variables found in some studies to affect adjustment to shift work are characteristics of the shift schedule itself (e.g. number

of nights on duty, speed of rotation), degree of experience with shift work, age (younger workers adapt more readily than older ones), physical fitness, psychological variables such as introversion or being an "evening type" rather than a "morning type," family circumstances, and ability to organize one's family or social life around the shift schedule (referred to, curiously, as "commitment" by some authors). The psychological benefit of feeling in control of the shift work schedule (as might occur, for example, in people who have the option of choosing their schedules of work) may also be important to adjustment but has not been studied systematically.

Gender differences in circadian rhythms and in adjustment of these rhythms to shift work have been studied only rarely, and no definitive conclusions can be drawn (Asso, 1987).

Figure 1 lists recent studies of health outcomes of shift work in nursing, and the key findings are discussed below. The only definitive statement that can be made about shift work and nurses' health is that nurses working night and rotating shifts suffer more sleep disturbances than other nurses and may be at higher risk for various other health problems.

Sleep Disturbances: Sleep disturbances are of interest in studies of shift work because deficits in the quantity or quality of sleep are associated with physical or emotional disorders and with

Fig. 1 Studies of Health Consequences of Shift Work in Nursing

STUDY	SAMPLE	SHIFTS COMPARED	MAJOR FINDINGS
Bryden & Holdstock, 1973	12 nursing students in 1 hospital in South Africa (all female)	Day Shift, night shift in same nurses	Daytime sleep was shorter than night sleep and had more interruptions. REM sleep occurred sooner in day than in night sleep.
Felton, 1976	39 nurses in Hawaii (all female)	Night shift, post-night duty in same nurses	Peak body temperature and urine excretion of sodium, potassium, creatinine and osmolality occurred later in the day in nurses on night duty. After returning to day shift, nurses' urinary sodium, creatinine, and osmolality cycles returned to baseline pattern, but temperature and potassium did not after 10 days of followup. Fewer hours of sleep and poorer quality of sleep reported while on night duty.
Folkhard et al., 1978	30 nurses in 1 hospital in England (all female)	Early and late day shifts, permanent night shift (full-time: 4 nights/week, and part-time: 2 nights/week)	Circadian rhythms (oral temperature, subjective alertness and well being) of full-time night nurses showed greater adjustment than part-time nurses, both on first night shift and in adjustment from first to second nights. Part-timers reported less sleep and less "calmness" on waking.
Gadbois, 1981	898 nurses and nursing auxiliaries in 61 hospitals in France (all female)	Fixed night work only (varied number of nights on duty)	Self-reported sleep duration was shorter, and sleep interruptions more frequent, for married women with children than for unmarried women. Mothers with young children went to bed later in the day.

STUDY	SAMPLE	SHIFTS AND COMPARED	MAJOR FINDINGS
Harna et al., 1988	128 nurses and nursing aides in 1 hospital in Finland (all female)	Irregular rotating shifts only (combinations of day, evening, night shifts in 3-week cycles)	Neuroticism and morningness were found to increase shift-cycle fatigue, and greater maximal oxygen consumption decreased it. Morningness, older age, and having children decreased sleep duration after night shift. Shiftwork experience and morningness decreased sleep quality after night work, and oxygen consumption increased it. Gastrointestinal symptoms were increased by neuroticism, marriage, and older age. Neurovegetative symptoms were increased by marriage and neuroticism. Musculoskeletal symptoms were increased by marriage, neuroticism, and physical activity, and were decreased by oxygen consumption and muscle strength.
Hildebrandt & Stratmann, 1979	6 nurses in Germany	7-18 day period of night work compared with 10-day recovery period in same nurses	Three "evening type" nurses reacted to night work with flattening of circadian amplitude (temperature and heart rate) and greater tolerance. Three "morning type" nurses developed increased amplitude, higher amounts of subjective complaints (e.g. headache, nervousness or irritation), greater compensation for lost sleep, and lower subjective vigilance.
Infante-Rivard et al., 1989	418 nurses and nursing aides in 1 hospital in Canada (all female)	Fixed day, fixed evening (within both groups, comparisons between those with and without prior night work)	Prevalence of 9 sleep disorder symptoms ranged from 6 to 53%. Evening workers were at higher risk of not being alert and receptive at rising and at lower risk of early morning awakening. Prior night work was associated with day tiredness and quantity of sleep.
Ruchinski, 1989	146 RNs in 1 hospital in Cincinnati (all female)	Fixed shifts, rotating shifts	No differences by shift were found in menstrual interval, duration of flow, amount of flow, dysmenorrhea, intermenstrual bleeding, or secondary amenorrhea.

STUDY	SAMPLE	SCHEDULE COMPARED	MAJOR FINDINGS
LeClerc et al., 1988	824 nurses in 10 hospitals in France	Permanent day, permanent night, rotating without night, rotating with <5 nights/month, rotating with 5 + nights/month	For 38 health variables including symptoms and health services utilization, type of shift had poor explanatory power.
Matsumoto, 1978	5 nurses, in 1 hospital in Japan	Day shift, night shift in same nurses	Time in bed and total sleeping time were lower in daytime than nighttime sleep. Number of awakenings was greater in day sleep. Daytime sleep differed qualitatively from night sleep in appearance of REM and NREM sleep.
Minors & Waterhouse, 1983	26 nurses	Single nights, paired nights, nights in blocks of 3+	Nurses working single nights maintained a conventional diurnal routine. Nurses working a number of consecutive nights showed changes in routine, including afternoon napping and different meal times.
Minors & Waterhouse, 1985	14 volunteer nurses in 1 hospital in England (79% female)	Short-term night shift (1-3 successive nights), long-term night shift (>3 successive nights)	Nurses working >3 successive nights were better adjusted to nocturnal activity and diurnal sleep, as reflected in amount of sleep, afternoon naps, and fewer subjective complaints.
Tasto et al., 1978; Smith et al., 1979	1,219 full-time nonsupervisory RNs & LPNs in 12 U.S. hospitals (98% female)	Fixed day, fixed afternoon/evening, fixed night, rotating	Nurses who rotate shifts took more sick days than fixed shift nurses, suffered more injuries, and reported more digestive trouble, leg and foot cramps, colds, nervousness and shaky feelings, fatigue and exhaustion, use of stimulants, use of beer and liquor, tension - anxiety, depression - dejection, confusion - bewilderment, neuroticism, sleep disturbances, and problems adjusting work schedules and family life.

STUDY	SAMPLE	SHIFTS COMPARED	MAJOR FINDINGS
Verhaegen et al. 1987	167 nurses in 6 hospitals in Belgium (all female)	Permanent night (full-time and part-time), 2-shift rotation with some nights	Rotating nurses reported more health complaints. Permanent nurses slept less than rotating nurses.
Webb, 1983	19 nurses aged 50-60 in 3 hospitals in Florida; compared with 40 50-60 year-old women university employees with no history of shiftwork	Current night shift with >10 years of rotating shift experience; nurses not on current shift work but extensive night or rotating shift experience; nurses not on current night shift and limited prior shift experience	Little evidence of enduring effect of night shift experience on sleep patterns. Some evidence of moderately changed REM sleep.

problems in alertness and performance that may produce injuries on the job. Disturbances of normal sleep patterns, measured through self-report or laboratory monitoring, are well documented in the general shift work literature.

All but one of the studies summarized in Figure 1 measured quantity and/or quality of sleep as a function of nurses' shift work. Outcomes studied included amount of sleep, sleep stages and rapid eye movement (REM) sleep, interruptions of sleep, and subjective fatigue. A frequent focus of interest has been the adaptation of sleep patterns to different amounts of night work. In general, nurses working night shifts involving only a few nights on duty and rotators had more sleep disturbances than other nurses, although few studies compared nurses on a variety of shifts or controlled for such variables as age, shift work history, and family circumstances. None of the studies examined the effects of chronic sleep disruption on nurses' health or work performance.

Several of the studies made a distinction between part-time and full-time night nurses (e.g. those working only two nights a week or in succession versus those working more than two nights a week or in succession) in an effort to study "short-term" versus "long-term" sleep adjustment to shift work. These studies found that full-time night nurses were better adjusted than part-time night nurses in terms of quantity and quality of sleep (Folkard et

al., 1978; Minors and Waterhouse, 1983 and 1985). Such adjustment was attributed in part to greater "commitment" to night work among the full-time night nurses as well as to greater compatibility of family situations with night work and day sleep among these nurses (e.g. no children at home). The findings also suggested that rapidly rotating shift work would be expected to result in greater sleep disturbances than slower rotation.

The dual issues of a selection effect (i.e. nurses selecting shift work based on compatibility with lifestyle) and of family roles as mediating variables in adjustment to night work were noted in most of the studies of shift work effects on nurses' sleeping patterns. Gadbois pointed out that for women night shift workers more than for men, family role responsibilities during non-working hours take precedence over the need to compensate for lost sleep. In a study of 898 nurses and nursing auxiliaries in 61 hospitals in France, Gadbois found that duration of sleep is greater among unmarried subjects than among married subjects with children; thus the nurse's social situation, not just her shift pattern, determined her sleep pattern (Gadbois, 1981).

Hanna and colleagues found that fatigue in nurses working nights (in a sample of nurses who worked various shifts at irregular intervals) was explained mainly by social factors (number of children, age, and being married or living with a partner) and that number of children also decreased the amount of

sleep after work on the night shift. In addition, being married increased the reported incidence of gastrointestinal symptoms (poor appetite, gaseous distention, heartburn, constipation and diarrhea), neurovegetative symptoms (nervousness and tautness, headache, nightmares, giddiness and nausea, palpitation or irregular heartbeat, handsweating, pricking or numbness of body parts, sexual unwillingness), and musculoskeletal symptoms (back symptoms; neck, shoulder or hip symptoms; knee or ankle symptoms) (Harma et al., 1988).

The NIOSH study found that nurses on fixed night shifts and on rotating shifts generally reported more problems with sleep, as compared with nurses on fixed day or fixed afternoon/evening shifts. This occurred for subjective reports of the general adequacy of sleep, trouble falling asleep, awakening during sleep and falling asleep after awakening, waking up feeling tired, and feeling tired during work. Although nurses on all four types of shifts studied reported desiring the same amount of sleep, nurses on fixed night shifts reported getting the least sleep. Further, rotating shift nurses, compared with those on fixed shifts, showed significantly higher incidence of fatigue and inadequate sleep patterns when the effects of age and marital status were controlled (Tasto et al., 1978).

Digestive Disorders: The NIOSH study reported data on nutritional

intake, appetite, and digestive problems among nurses by type of shift. Nurses on fixed afternoon/evening shifts reported better appetite than nurses on other shifts. Night shift nurses reported needing fewer meals in a 24-hour period than other nurses, and day shift nurses reported needing the most. Rotating shift nurses reported more snacking. Day nurses reported the most meals eaten with family or friends.

Rotating and day nurses reported significantly more bloating or feeling full; rotators and afternoon nurses reported more gastritis; and rotators had higher incidence of trouble digesting food. Rotating shift nurses showed a significantly higher incidence of digestion trouble than other nurses, when age and marital status were controlled (Tasto et al., 1978).

Minors and Waterhouse found that nurses working three or more consecutive nights, compared with those working single nights or only two nights in succession, exhibited greater adjustment in their meal times during a period of 12 consecutive days in which the nurses kept activity logs. The nurses working more nights tended to have their evening meal around midnight. These results were interpreted by the authors as consistent with the concepts of "commitment" to night shift work and of "long-term adaptation" (Minors and Waterhouse, 1983).

Psychological/Nervous Symptoms: Psychological variables may be

viewed as outcomes of shift work or as mediating variables. The NIOSH study used two instruments to measure psychological states: the Profile of Mood States (POMS) and the Eysenck Personality Inventory (EPI). On the POMS subscales, rotating nurses reported significantly higher tension-anxiety than afternoon/evening and night workers; rotators reported significantly more depression-dejection than day or night workers; rotating nurses reported significantly less vigor and more fatigue than all other shifts; and rotators reported significantly more confusion-bewilderment than all other shifts. On the EPI, rotators were significantly more neurotic than nurses on other shifts, while day shift nurses scored lower on sociability than afternoon/evening and night nurses (Tasto et al., 1978).

Harma and colleagues reported that neuroticism increased shift-cycle fatigue in nurses and also contributed to higher reported incidence of gastrointestinal, neurovegetative, and musculoskeletal symptoms (as described earlier), regardless of shift. (It is not possible to determine from this study whether type of shift influences neuroticism.) A measure of morningness-eveningness was also predictive: morningness decreased reported fatigue in morning shift nurses and increased it in evening shift nurses; morningness also decreased sleep duration and quality after night shift work (Harma et al., 1988).

The relationship between specific psychological/nervous

symptoms and degree of social participation, which may be reduced by shift work, is not known.

Menstrual Dysfunction: Few studies have examined the relationship between shift work and reproductive health in nurses, although environmental/occupational conditions may contribute to menstrual dysfunction (Keye, 1984). The NIOSH study included some indicators of menstrual dysfunction and found that nurses on fixed day shifts reported more irregular menstrual periods than other nurses, and nurses on all types of fixed shifts reported more menstrual cramps than did rotating nurses. Night and rotating nurses, however, reported spending more time lying down due to menstrual cramps, and rotating nurses reported more tension, nervousness, weakness, and sickness at menstruation as well as longer periods than did nurses on all other types of shift (Tasto et al., 1978).

Kuchinski conducted a 1986-87 study of the menstrual characteristics of 146 registered nurses aged 20 to 40 in a university hospital in Cincinnati. Forty-three percent of the nurses studied worked fixed shifts and 57% worked rotating shifts. No significant differences between these two groups of nurses were found for self-reported length of the menstrual interval, duration of flow, amount of flow, dysmenorrhea, intermenstrual bleeding, or secondary amenorrhea. The absence of findings could have been due

to the small sample size (Kuchinski, 1989).

Substance Use: Substance use is of interest in studies of shift workers because drugs may be used to induce sleep and/or to cope with work-related stresses. Gordon and colleagues provided some evidence from the National Survey of Personal Health Practices and Consequences that U.S. women workers aged 20-64 who worked variable shifts (combining both day and night work) in 1980 were more likely than comparable men to use sleeping pills, tranquilizers, and indigestion aids; men, on the other hand, were more likely to use alcohol, coffee, and cigarettes. Since the study did not distinguish prescription from non-prescription medications, it is not possible to assess whether women's greater use of medications was associated with health care utilization. Adjusting for age, income, and education, women working variable shifts, compared with women working non-variable shifts, were at higher risk for use of sleeping pills or tranquilizers and for heavy drinking (Gordon et al., 1986).

Only the NIOSH study has reported differences in nurses' substance use by type of shift. Rotating nurses, compared with the three types of fixed shift nurses, were more likely to use stimulants; rotating and afternoon shift nurses drank more beer; rotating nurses drank more liquor of all kinds; rotating and day shift nurses were more likely to drink on work days. Night nurses

were more likely to report drinking before going to work. The information obtained on quantity of alcohol consumed was limited, and no conclusions can be drawn regarding alcohol dependency. Similarly, it is not possible to determine from the reported data whether drinking on work days occurs during or outside of work hours or whether drinking on work days causes problems in work performance (Tasto et al., 1978).

Injuries: Injuries to shift workers are studied because it is presumed that fatigue and impaired cognitive and psychomotor function during shift work are likely to produce work place injuries. Lab studies have shown, for example, that speed, reaction time, and accuracy decline after evening hours, suggesting that more accidents and injuries are likely to occur at night (Finn, 1981). Some performance indicators (such as alertness and reaction time) that could be associated with errors and injuries in the work place have been found to be related to body temperature, which is affected by night and rotating shift work in particular (Rutenfranz et al., 1977; Tasto et al., 1978).

Only the NIOSH study and a subsequent analysis of those data by Smith and colleagues have reported injuries by type of shift worked by nurses. Data from health and safety records of 1,228 nurses revealed that rotating shift workers suffered more injuries than fixed shift workers. Injury rate was not influenced by age,

length of employment, or marital status. Furthermore, cuts, bruises, and punctures (mainly to fingers) were the most frequent category of injury on all shifts, and rotating nurses had significantly more such injuries than nurses on fixed shifts (Smith et al., 1979).

C. Work Performance

Studies of the work performance of shift workers have generally focused on lost productive time as a consequence of health problems (e.g. absenteeism due to illness or health services utilization) and on errors and injuries as a consequence of fatigue or disrupted circadian rhythms. A few studies of nurses have reported results for sick days, health services utilization, self- or supervisor-reported performance levels, and various indicators of quality of patient care.

Sick Days and Health Services Utilization: The NIOSH study used employee records to study sick days and clinic visits by nurses on four shifts. (Sick days alone are not a reliable indicator of health problems, since sick days are limited by personnel policies.) They found that rotating nurses tended to take more sick days than nurses on any type of fixed shift and that rotators tended to have more serious reasons for taking sick days (e.g.

acute respiratory infection, upper-gastrointestinal tract distress) as compared with fixed shift nurses. With regard to clinic visits, rotating nurses attended worksite clinics during work hours more frequently than fixed shift nurses and for a wider array of health complaints (Tasto et al., 1978). The implication of these results for job performance is that rotating nurses lose more time from work (due to both sick days and clinic visits) and may be less productive on the job if they are experiencing more serious health problems.

Job Performance Ratings: A few studies of shift work effects on the job performance of individual nurses have used self-reports of performance or the reports of supervisors. The NIOSH study found that nurses on fixed afternoon/evening and rotating shifts reported lower levels of satisfaction with their work performance than did fixed night and fixed day nurses (Tasto et al., 1978). Another study found that nurses on rotating shifts received lower job performance ratings by their supervisors as compared with nurses on fixed shifts (Jamal and Jamal, 1982).

In a recent study of job performance and job-related stress in 482 RNs in five hospitals in the southeastern United States, self-reported job performance was examined in relation to type of shift worked. On overall job performance, rotators reported the lowest performance level, followed by fixed afternoon nurses,

fixed night nurses, and fixed day nurses. Using a multidimensional measure of job performance, the investigators found that only one of six dimensions was significantly associated with shift: on performance with regard to professional development, rotating and fixed afternoon nurses scored lower than fixed day and fixed night nurses. There were no significant differences by shift for leadership, teaching/collaboration, planning/evaluation, or interpersonal relations/communications. (The items comprising the various scales were not presented.) Rotating nurses also reported the highest levels of job-related stress. These relationships held when anticipated turnover, position level, and length of time on the present shift schedule were controlled (Coffey et al., 1988).

Quality of Patient Care: Very little research has been conducted on the relationship between shift work and quality of patient care by nurses. The few studies that have addressed shift work effects on quality have been small-scale evaluations of shift work demonstration projects.

In nursing studies in general, quality of care typically is measured in terms of the nursing care process rather than patient outcomes. Process measures of quality usually take place at the unit level and involve chart audits in which raters examine nursing care plans to determine whether or not specific procedures

have been recorded. Alternative methods involve direct observations of nursing procedures, in which a rater assesses performance along a number of dimensions. Other indicators of quality in the literature include incident reports (medication errors, accidents/injuries) and patient satisfaction.

The available literature seems to postulate two mechanisms by which shift patterns might affect quality of nursing care: (1) shift work patterns that are more satisfying to nurses would be expected to result in greater nurse retention, unit cohesiveness, and continuity of care across shifts, and (2) shift work patterns that are more compatible with circadian rhythms would be expected to result in less fatigue and increased alertness on the job.

A four-month trial of the 4-40 workweek (four 10-hour days per week) in a pediatrics unit employing both RNs and LPNs was conducted at University Hospital in Seattle, Washington. The study was a one-group, pretest-posttest design. The new scheduling system, compared with the traditional 8-hour, five day shift system, was expected to improve quality of care, defined in terms of intershift continuity of care. A 4 1/2 hour overlap between day and evening shifts was expected to facilitate such continuity. Process measures of nursing care quality revealed little change pre- and post-initiation of the 4-40 workweek, although staff reports of quality showed improvement (Kent, 1972).

At the Holy Cross Hospital of Calgary, a 12-hour shift system

was introduced on an intensive care unit staffed by 24 registered nurses and was evaluated using a one-group pretest-posttest design over a six-month period. The impact of the 12-hour shift, compared with the traditional 8-hour shift pattern, was measured with regard to nurses' job satisfaction, interpersonal relations in the work environment, nurses' health status, nurses' fatigue and alertness, and quality of patient care. No significant differences were found between types of shift for alertness (reaction times) or fatigue, although within the 12-hour shift system, reaction time was faster for day-shift than for night-shift nurses. Using retrospective chart audit scores, the investigators found no significant difference in the quality of nursing care between the first six months of the 12-hour shift and the corresponding period of the previous year. Data from incident reports (accidents, injuries, and medication errors) showed no change in the number of incidents per 100 patient days with the change to 12-hour shifts (Eaton and Gottselig, 1980).

In a pilot study of 12-hour shifts in a surgical intensive care unit, Mills and colleagues measured quality of patient care prior to implementation of 12-hour shifts and one year later. They found some evidence of increased subjective fatigue and decreased accuracy on performance tests after the nurses were working 12-hour shifts, but evidence from chart audits revealed no significant changes, though nurses' perceptions of their

performance did increase (Mills et al., 1983).

One study compared 10 RNs working 8-hour shifts with 10 RNs working 12-hour shifts in the intensive care units of two midwestern hospitals. The Quality Patient Care Scale (QUALPACS) was administered by an observer to provide concurrent ratings of patient care provided by each nurse. Only one of five behavior categories rated by the QUALPACS demonstrated a statistically significant difference between 8- and 12-hour shift workers, although nurses on 12-hour shifts scored lower than nurses on 8-hour shifts on all of the dimensions. Since most of the 12-hour nurses volunteered comments about the fatigue they experienced, the investigators interpreted these results as indicating potential problems with quality of care on 12-hour shifts (Nelson and Blasdell, 1988).

It is not known how extended work days and compressed work weeks affect patients' satisfaction with nursing care. Conceivably, patients could react differently to various shift schedules depending on the availability of their primary nurse caretaker. One study reports anecdotal evidence of patient satisfaction with a 12-hour shift system in which nurses worked seven consecutive 12-hour days followed by seven days off (Ganong et al., 1976). However, patients who do not see their primary nurse for days at a time may experience this as discontinuity in their care process.

IV. Conclusions and Recommendations

A number of limitations of the available information about shift work in nursing already have been noted. These include the absence of national data on nurses' shift work prevalence and career experience with shift work; few studies of the short-term or long-term consequences of shift work for nurses' family and social participation, health, and work performance; and few studies of the impact of different shift schedules on the quality of patient care. These limitations are due in part to a general lack of research attention to shift work issues among women workers. However, the paucity of data also reflects prevailing assumptions about the effectiveness of shift differentials in solving shift-specific staffing problems and about the ease with which resigning nurses can be replaced, at least until recently, by a steady stream of new graduates who will be willing to work shifts for a period of time early in their careers. Declining enrollments in nursing schools and increased demand for RNs may now be prompting more health care administrators to examine shift work policies and to experiment with alternatives as a means of improving recruitment and retention of nurses.

More research is needed on the short- and long-term effects of shift work on a range of nurses' health outcomes and on work performance. While the NIOSH-supported project cited throughout

this paper was an important study of a number of health consequences of shift work in a large sample of registered nurses, it was cross-sectional, relied primarily on self-reported symptoms, and contained few measures of other job attributes (e.g. workload, degree of control over work-related decisions, method of shift assignment) that could be confounded with type of shift worked.

Furthermore, the working conditions of hospital nurses have changed since the NIOSH study was conducted in the late 1970s. Hospital nurses today are coping with decreased length of patient stay and increased patient acuity as a consequence of prospective reimbursement of hospitals. These factors may exacerbate work stress and health problems in general, independent of shift work, or they may interact with shift work to produce extremely high stress levels among those nurses working undesirable shifts and confronting patients who require more intense nursing care. These factors may also offset any positive effects of experiments with alternative shift schedules as a recruitment or retention strategy. Thus the relevance of previous research to the current hospital environment is not known.

Other specific recommendations with regard to nursing and shift work are presented below.

- Organizations requiring shift work should maximize opportunities for nurses' control over shift schedules. The

studies cited earlier suggest that shift work is associated with nurses' perceptions of low job control and that control can be an important element in an individual's adjustment to shift work. In addition, a prominent model of work stress developed by Karasek and colleagues posits that the jobs most likely to create strain and to precipitate job dissatisfaction and health problems are those that combine high job demands with low decision latitude (Karasek, 1979; Karasek et al., 1987). This combination of job attributes has been linked with a variety of health problems, including cardiovascular disease (Johnson and Hall, 1988; Johnson, 1989). A plausible hypothesis in the context of today's more demanding nursing jobs would be that greater control of the work environment, including shift work, will reduce nurses' overall levels of job stress and consequent health problems.

The concept of control of shift work includes two dimensions: (1) control over one's own shift assignments, through some type of bidding procedure, ideally including the option of trading shift assignments as needed, and (2) control over the shift policy of the organization or organizational subunit, through participation in formulation of shift work policies and design of the shift system. Theoretically, increased control would enable nurses to select schedules more compatible with their individual circadian rhythms and/or family circumstances. In addition, participation in the formulation of shift policy for the organization should

result in nurses having better information about the problems of managing a shift system, in nurses contributing new ideas about shift system design, and in nurses sharing a sense of commitment to the shift system devised.

- Organizations implementing alternative shift schedules should evaluate their impact on nurses' health, nurses' job performance, and quality of patient care. While shift schedule alternatives are often implemented for purposes of improving nurse recruitment or retention, there may be important unanticipated consequences for other aspects of nurse performance, for health, and for patient care. For example, too little is known about the relationship between fatigue and quality of patient care to assume that extended work days such as 12-hour shifts will not have negative consequences for patient care.

Although sleep disruption and fatigue are the best documented consequences of shift work in nursing samples, little attention has been given to ultimate consequences for patient care. The few available studies suggest that there might be quality of care problems associated with longer (12-hour) shifts. The best unit of analysis for research in this area might be the nursing unit, rather than the individual nurses, since measurement at the unit level reduces the impact of individual differences in circadian rhythm adjustment. In addition, many indicators of performance are maintained in hospitals at the unit level; these include

incident reports and nursing audit scores.

Unit level studies would require comparing units that operate on different shift systems (e.g. fixed 8-hour versus fixed 12-hour shifts), that include different proportions of nurses who rotate shifts, or that provide different degrees of control over shift assignments. For example, one plausible hypothesis would be that units that minimize shift rotation are more likely to function as intact teams with highly developed group cohesiveness and better work performance.

The concept of control over shift might be operationalized as follows. Least control might be indicated by a traditional system in which head nurses post shift schedules, the staff nurse negotiates with the head nurse for a schedule change, and desirable shifts are a function of seniority. Intermediate levels of control might be indicated by the presence of a system for nurses to bid on schedules and/or to trade shift assignments when conflicts arise. High levels of control might be indicated by the presence of a system in which nurses in a particular organizational unit design their own shift systems and determine their own shift assignments.

- Organizations requiring shift work should provide support services for nurses who must work undesirable shifts and who have difficulty adjusting. As discussed earlier, the social environment poses structural barriers to shift work adjustment.

The majority of nurses have family responsibilities, and those with young children appear to have the most difficulty adjusting to night or rotating shifts, at least with regard to sleep and meal schedules. Furthermore, women in our society, even those in dual-career families, generally have responsibility for managing as well as performing the majority of household tasks. The additional burden of shift work probably exacerbates the difficulties of coordinating work and home life for the majority of nurses and creates stresses for other family members.

Such support services as child care (including child care for mildly ill children), elder care, household assistance, family counseling, and substance abuse counseling could be provided through a combination of flexible benefits packages and employee assistance programs. In addition, the health care benefits of nurses required to work shifts should cover prevention and treatment services related to the major health problems associated with shift work, including sleep disorders.

Endnotes

1. This report pertains to registered nurses. Nursing personnel in the U.S. health care industry include registered nurses, licensed practical/vocational nurses, and unlicensed ancillary personnel including nursing aides. It is estimated that these three occupations included over 3 million persons employed in health care in 1984, of whom 1.5 million were registered nurses (U.S. Department of Health and Human Services, 1988).

2. In this paper, the term "shift work" refers to a work schedule, either full-time or part-time, that requires working other than regular daytime hours. Thus shift work includes permanent non-daytime shifts (e.g. evening or night shifts), split shifts, and rotating shifts. This is consistent with the definition used in reports of a May 1985 special supplement to the Current Population Survey (Mellor, 1986). In May 1985, 84.1% of full-time wage and salary workers aged 16 years and over reported working a regular daytime schedule; the occupations with the highest percentage of shift workers were protective service workers (with 61% working shifts) and food service workers (43% working shifts) [Mellor, 1986]. These data would underestimate shift work prevalence if the definition were modified to include weekend work hours.

3. In nursing, the day "shift" typically refers to the 8-hour shift occurring during daytime hours (e.g. 7:00 am to 3:30 pm), as contrasted with evening (e.g. 3:00 pm to 11:30 pm) and night (e.g. 11:00 pm to 7:30 am) shifts. In this paper, nurses who work fixed day shifts are not regarded as shift workers.

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